Lab 6 Calculations Sheet

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April 1, 2020

1. Weight ($\vec{F_{g_i}}$) in newtons (N)

$$\begin{aligned}
\vec{F_{g_i}} &= m_i \cdot \vec{g} && (1)\\
&= (0.100kg) \cdot (9.81\frac{m}{s^2}) && (2)\\
&= 0.981N && (3)
\end{aligned}$$

2. Gravitational Potential Energy (U_{g_i}) in joules (J)

$$\begin{aligned}
E_1 = U_{g_i} &= m \cdot \vec{g} \cdot (x_{2_i} - x_{1_i}) && (4)\\
&= (0.500kg) \cdot (9.81\frac{m}{s^2}) \cdot (0.893m - 0.300m) && (5)\\
&= 2.908665J \approx 2.91J && (6)
\end{aligned}$$

3. Spring Potential Energy (U_{s_i}) in joules (J)

$$\begin{aligned}
E_2 = U_{s_i} &= \frac{1}{2} \cdot k \cdot (x_{2_i}^2 - x_{1_i}^2) && (7)\\
&= \frac{1}{2} \cdot 8.46\frac{N}{m} \cdot ((0.893m)^2 - (0.300m)^2) && (8)\\
&= 2.99250927J \approx 2.99J && (9)
\end{aligned}$$

4. Percent Difference ($\%Diff$)

$$\begin{aligned}
\%Diff &= 2 \cdot \frac{(U_{g_i} - U_{s_i})}{(U_{g_i} + U_{s_i})} \cdot 100\% && (10)\\
&= 2 \cdot \frac{(2.91J - 2.99J)}{(2.91J + 2.99J)} \cdot 100\% && (11)\\
&\approx -2.71\% && (12)
\end{aligned}$$

LLSF Data Table

	$x(m)$	$mg(N)$	$x \cdot mg(J)$	$x^2(m^2)$	$mg^2(N^2)$	$mg_{LLSF}(N)$
1	0.121	0.981	0.119	0.0146	0.962	0.98
2	0.239	1.96	0.469	0.0571	3.85	1.97
3	0.354	2.94	1.04	0.125	8.66	2.95
4	0.466	3.92	1.83	0.217	15.4	3.90
5	0.587	4.91	2.88	0.346	24.1	4.92
	$\sum(x)$	$\sum(mg)$	$\sum(x \cdot mg)$	$\sum(x^2)$	$\sum(mg^2)$	
Σ	1.767	14.72	6.34	0.759	52.9	

5. Slope (m) and Spring Constant (k) in newtons per meter ($\frac{N}{m}$)

$$k = m = \frac{N \cdot \sum(x \cdot mg) - \sum(x) \cdot \sum(mg)}{N \cdot \sum(x^2) - (\sum(x))^2} \tag{13}$$

$$= \frac{5 \cdot 6.34J - 1.767m \cdot 14.72N}{5 \cdot 0.759m^2 - (1.767m)^2} \tag{14}$$

$$\approx 8.46\frac{N}{m} \tag{15}$$

6. Intercept (b) in newtons (N)

$$b = \frac{\sum(mg) \cdot \sum(x^2) - \sum(x \cdot mg) \cdot \sum(x)}{N \cdot \sum(x^2) - (\sum(x))^2} \tag{16}$$

$$= \frac{14.72N \cdot 0.759m^2 - 6.34J \cdot 1.767m}{5 \cdot 0.759m^2 - (1.767m)^2} \tag{17}$$

$$\approx -0.0479N \tag{18}$$

7. LLSF (mg_{LLSF_i}) in newtons (N)

$$mg_{LLSF_i} = m \cdot x_i + b \tag{19}$$

$$= 8.46\frac{N}{m} \cdot 0.121m - 0.0479N \tag{20}$$

$$\approx 0.98N \tag{21}$$

8. Correlation (r)

$$r = \frac{N \cdot \sum (x \cdot mg) - \sum (x) \cdot \sum (mg)}{\sqrt{N \cdot \sum (x^2) - (\sum (x))^2} \cdot \sqrt{N \cdot \sum (mg^2) - (\sum (mg))^2}} \tag{22}$$

$$= \frac{5 \cdot 6.34J - 1.767m \cdot 14.72N}{\sqrt{5 \cdot 0.759m^2 - (1.767m)^2} \cdot \sqrt{5 \cdot 52.9N^2 - (14.72N)^2}} \tag{23}$$

$$\approx 1.00 \tag{24}$$